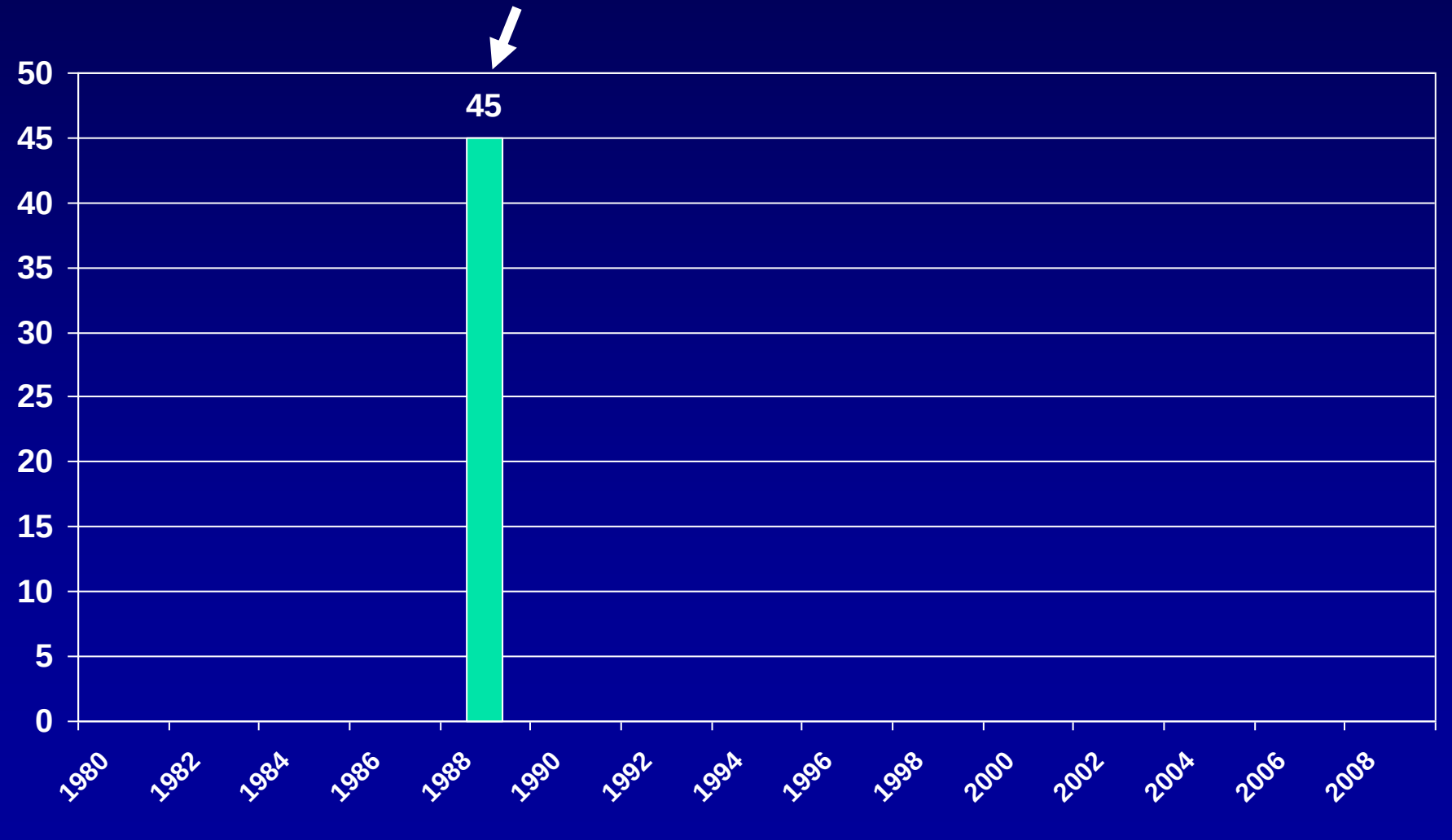
Dental Implants – How many systems do we have and are they documented?

Asbjørn Jokstad, DDS, PhD
Professor and Head, Prosthodontics
Faculty of Dentistry, University of Toronto

Number of dental implants 1988

English CE. Implants. Part three. An overview. California Dent Assoc J. 1988;16: 34-8.



Review of existing literature

Eckert S et al. Validation of dental implant systems through a review of literature supplied by system manufacturers. J Prosthet Dent 1997;77: 271-9.

Conclusion:

On the basis of the literature supplied by the manufacturers, only one implant system demonstrated scientifically valid long-term success.

Situation, 1999

1. The number of implants and implant systems increase continuously worldwide
2. The FDI World Dental Federation is concerned about the quality of all the new implants being marketed
3. The FDI Science Committee is asked to investigate the issue
4. The work is commissioned to prof. A Jokstad

Implant brands/ systems available in N. America in 1999 (n=98)

REVIEW ARTICLE

Implants and Components: Entering the New Millennium

Paul P. Binon, DDS, MSD[1]

The elusive dream of replacing missing teeth with artificial analogs has been part of dentistry for a thousand years. The coincidental discovery by Dr P-I Brånemark and his coworkers of the tenacious affinity between living bone and titanium oxides, termed *osseointegration*, propelled dentistry into a new age of reconstructive dentistry.

Initially, the essential tenets for obtaining osseointegration dictated the atraumatic placement of a titanium screw into viable bone and a prolonged undisturbed, submerged healing period. By definition, this required a 2-stage surgical procedure. To comply, a coupling mechanism for implant placement and the eventual attachment of a transmucosal extension for restoration was explored. The initial coronal design selected was a 0.7-mm-tall external hexagon. At its inception, the design made perfect sense, because it permitted engagement of a torque transfer coupling device (fixture mount) during the

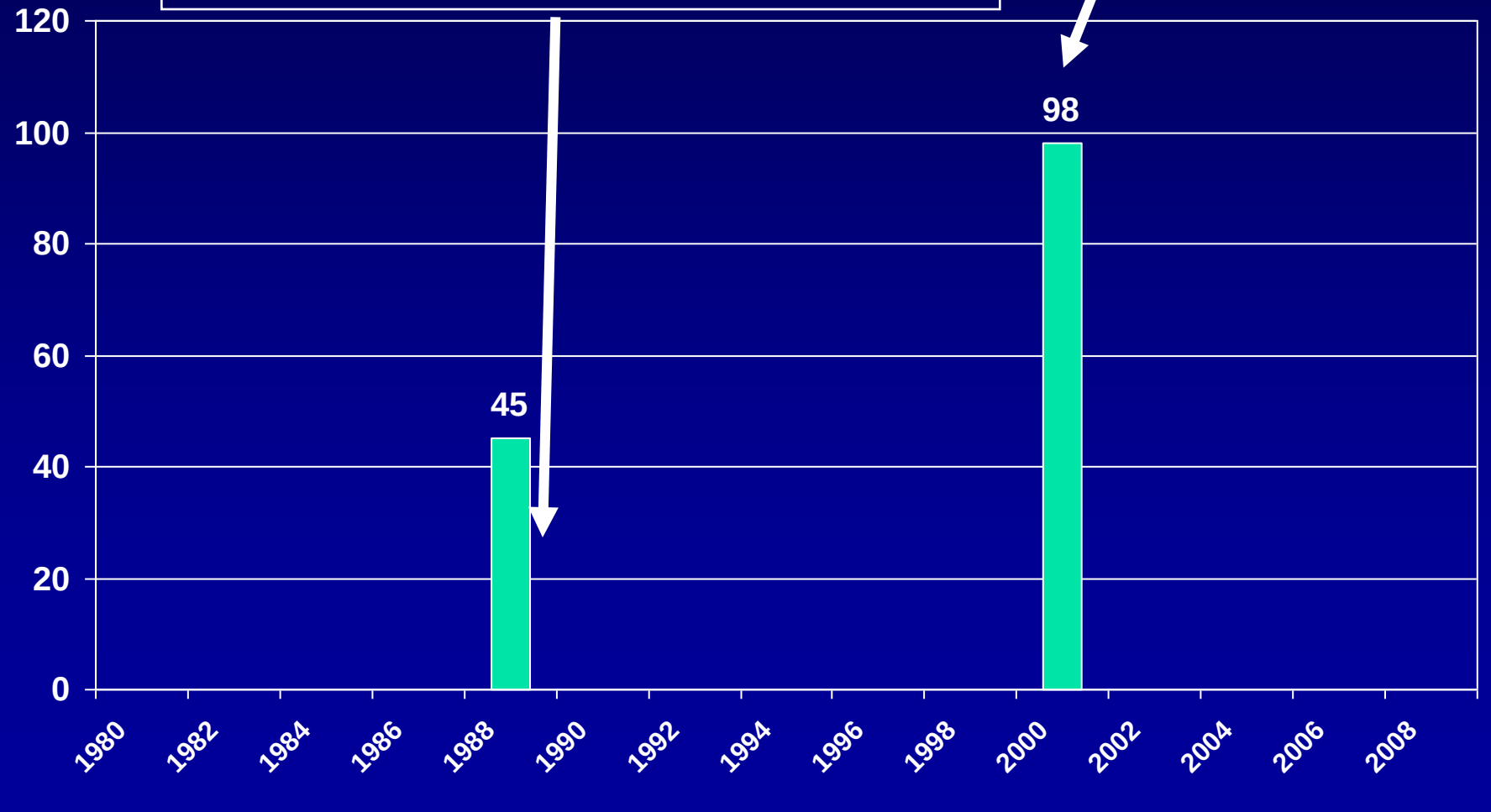
replacement, maxillofacial and a myriad of other applications, limited only by the ingenuity and skill of the clinician.[11–13] The external hexagonal design, ad modum Brånemark, originally intended as a coupling and rotational torque transfer mechanism, consequently evolved by necessity into a prosthetic indexing and antirotational mechanism.[14,15] The expanded utilization of the hexagonal resulted in a number of significant clinical complications.[8–11,16–22] To mitigate these problems, the external hexagonal, its transmucosal connections, and their retaining screws have undergone a number of modifications.[23] In 1992, English published an overview of the then-available external hexagonal implants, numbering 25 different implants, all having the standard Brånemark hex configuration.[14] The external hex has since been modified and is now available in heights of 0.7, 0.9, 1.0, and 1.2 mm and with flat-to-flat widths of 2.0, 2.4, 2.7, 3.0, 3.3, and 3.4 mm,

Int J Oral Maxillofac Impl 2000 15(1): 76-95

Number of implants 2000

Binon PP.Implants and components: entering the new millennium. Int J Oral Maxillofac Implants. 2000;15:76-94.

English CE. Implants. Part three. An overview.CDA J. 1988;16: 34-8.



Jokstad, Brägger, Brunski, Carr, Naert, Wennerberg. Int Dent J 2003; 53 Sup 2: 409-33

Asbjørn Jokstad, Oslo, Norway
Urs Braegger, Bern, Switzerland
John B. Brunski, Troy, USA
Alan B. Carr, Rochester, USA
Ignace Naert, Leuven, Belgium
Ann Wennerberg, Gothenburg, Sweden

Commercially available implant and implant systems in October 2003:

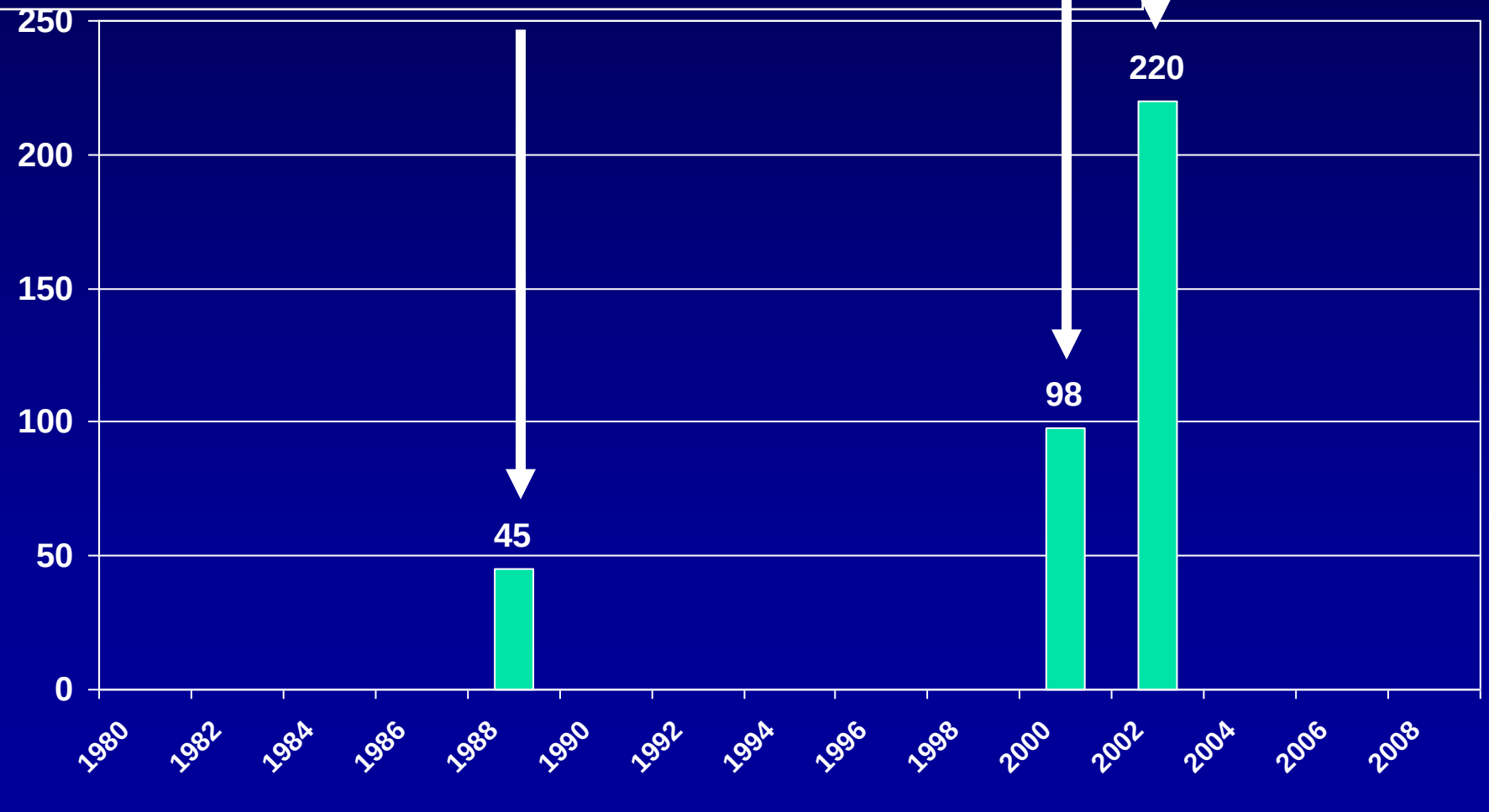
225 implant brands
78 manufacturers – from all continents
~70 implant brands no longer marketed

Number of implants 2003

Jokstad A, et al. Quality of dental implants. Int Dent J. 2003;53(6 Suppl 2):409-43

Binon PP..Implants and components: entering the new millennium. Int J Oral Maxillofac Implants. 2000;15:76-94.

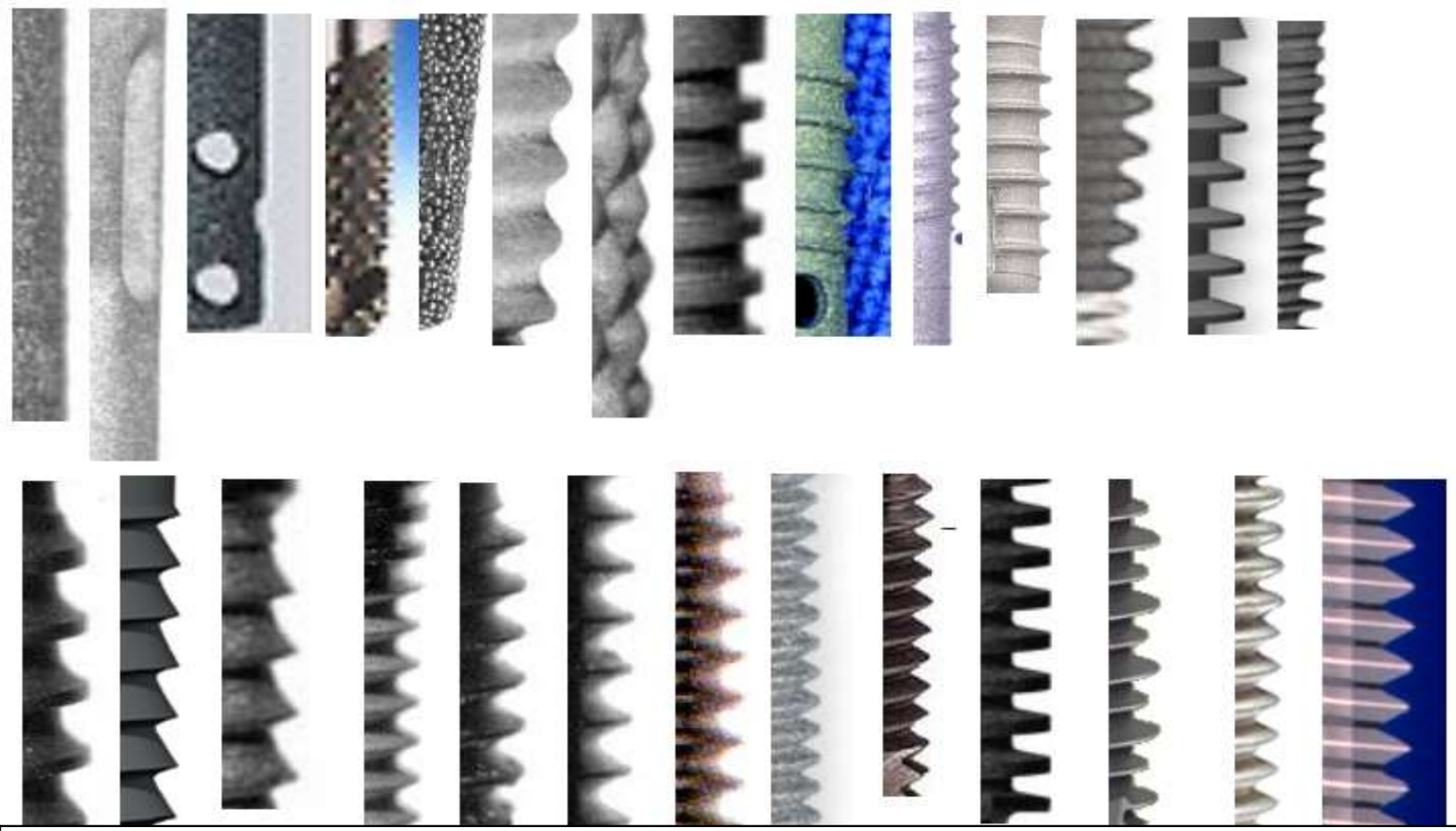
English CE. Implants. Part three. An overview. CDA J. 1988;16: 34 8.



Straight, Tapered, Conical, Ovoid, Trapezoidal, Stepped & combinations …

Flange design

- Flange vs. no flange
- Straight vs. flared vs. widening
- Height
- Polished vs. threads
- Added features
- Surface topography



- Threads vs. non-threads
- Shape: V- vs. square- vs. reverse buttress- vs. combinations
- Number and size of “lead threads”
- Number and location of grooves, groove forms and groove sizes
- Surface micro-topography
- Thread angle

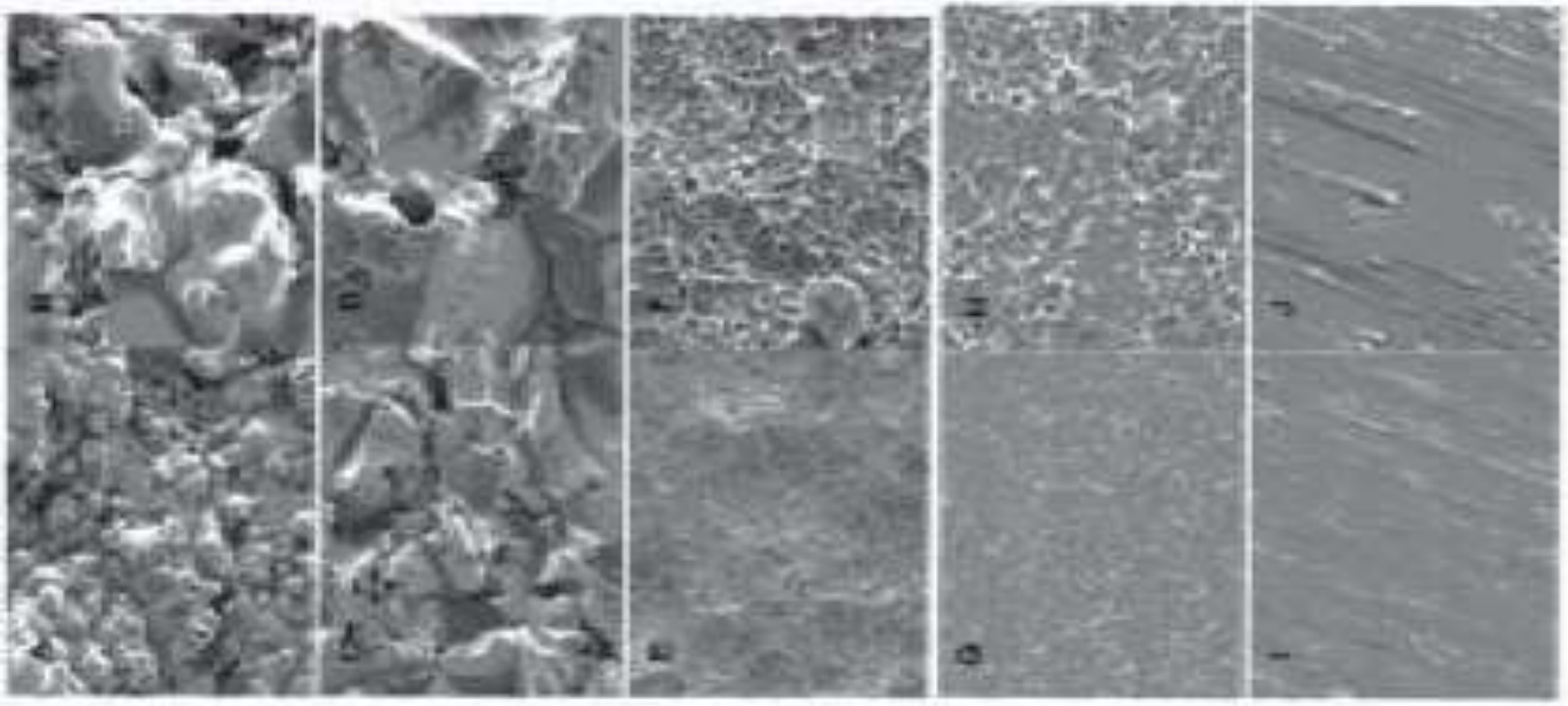
Apex

- Threaded vs non-threaded
- V-shape vs flat vs curved apex
- Holes, round, oblong
- Apical chamber
- Grooves and groove size
- Flared apex
- Surface topography

Interface geometry

- External vs Internal
- Hexagonal vs. Octagonal vs cone
- Morse taper
- Rotational vs non-rotational
- Added non-rotational features
- Heights & widths
- Butt vs bevel joints
- Slip-fit vs friction-fit joints
- Resilience vs nonresilience ….

High (top) and low (bottom) magnification of cpTi surfaces as used for surface characterization.



Plasma–sprayed (TPS);

Grit-blasted

Grit-blasted and dual acid-etched

Dual acid-etched

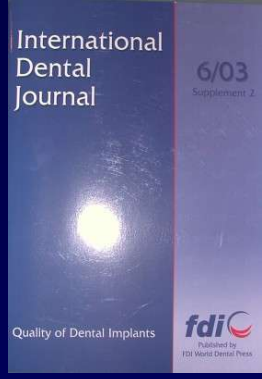
Machined (turned)

Davies, 2003

Surface topography	Machining process	Example
Anisotropic with oriented cutting marks	Turned	Brånemark System® MKIII (Nobel Biocare)
Isotropic	Blasted	TiO2 particles (Tioblast®, AstraTech)
Isotropic	Blasted + acid etched	1. Large size Al2O3 particles & HCl & H2SO4 (SLA®, Straumann) - 2. Tricalcium phosphate & HF & NO3 (MTX®, Centerpulse)
Isotropic with high frequency irregularities	Acid etched	HCl / H2SO4 (Osseotite®, 3i)
Isotropic and rough	Hydroxyapatite coated	Sustain® (Lifecore)
Isotropic and rough	Titanium Plasma Sprayed	ITI® TPS (Straumann)
Isotropic with craterous structure	Oxidized	TiUnite® (Nobel Biocare)

Clinical documentation?

Clinical documentation



A. Implant or implant system with extensive clinical documentation: >4 clinical trials — **10**

B. Implant or implant system with limited clinical documentation, i.e. <4 trials, but of good methodological quality — **11**

C. Implant or implant system with limited published clinical documentation — **29**

D. Implant or implant system with no published clinical documentation. — **28**

Quality Assessment of Randomized Controlled Trials of Oral Implants

Marco Esposito, DDS, PhD[1]/Paul Coulthard, BDS, MFGDP, MDS, FDSRCS, PhD[2]/
Helen V. Worthington, BSc, MSc, PhD, FIS[3]/Asbjørn Jokstad, DDS, PhD[4]

The aim of this study was to assess the quality of randomized controlled trials (RCTs) concerned with the effectiveness of oral implants and to create a trial register. A multilayered search strategy was used to identify all RCTs published by the end of 1999 in any language. The Cochrane Oral Health Group specialist register, PubMed, and personal libraries were searched. Seventy-four RCTs were identified. Forty-three articles, not presenting the same patient material, were independently assessed by 3 researchers using a specially designed form. A statistician assessed all trials for the appropriateness of statistics. The quality of each study was assessed on 7 items, including 3 key domains. Randomization and concealment allocation procedures were not described in 30 articles (70%). Reasons for withdrawals were not given in 10 reports (23%). No attempt at blinding was reported in 31 studies (72%). The quality of RCTs of oral implants is generally poor and needs to be improved. (Int J Oral Maxillo-

The quality of RCTs of oral implants is generally poor and needs to be improved

Esposito et al., IJOMI 2001; 16: 783-92

How many new implant systems?

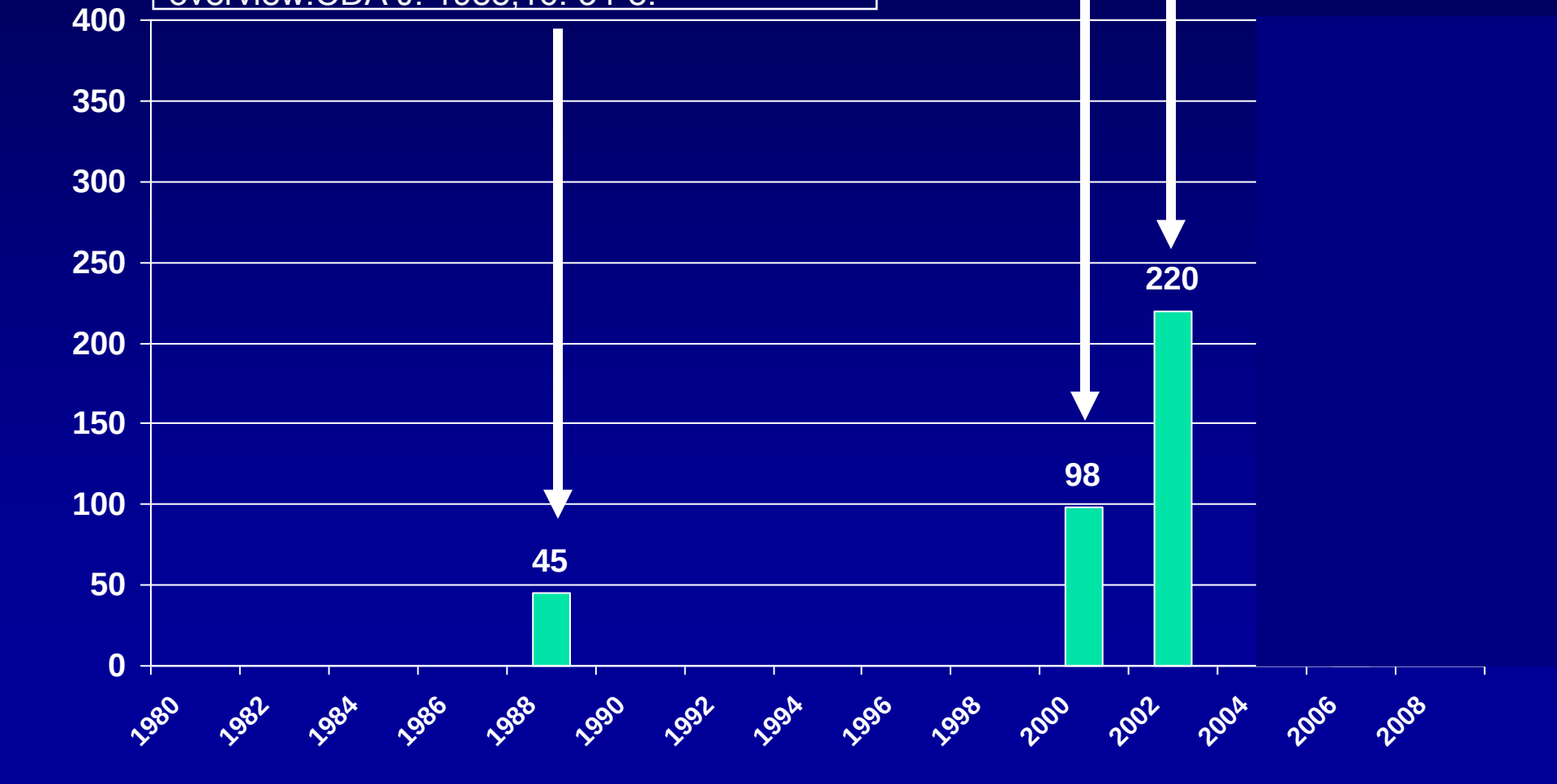
Number of implants 2006

Jokstad A, et al. Quality of dental implants. Int Dent J. 2003;53(6 Suppl 2):409-43

Binon PP.Implants and components: entering the new millennium. Int J Oral Maxillofac Implants. 2000;15:76-94.

English CE. Implants. Part three. An overview.CDA J. 1988;16: 34-8.

Jan 2007

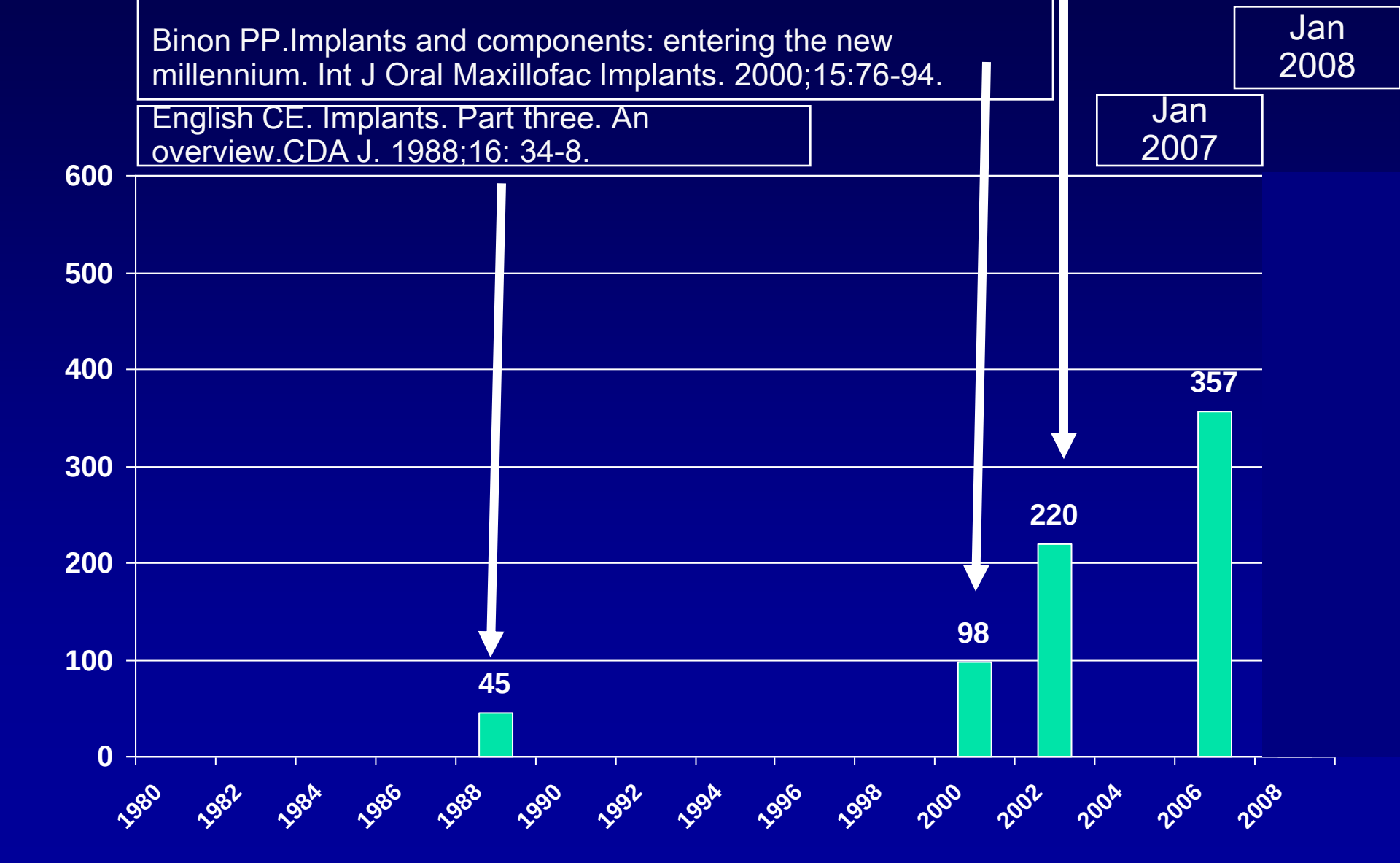


Number of implants 2008

Jokstad A, et al. Quality of dental implants. Int Dent J. 2003;53(6 Suppl 2):409-43

Binon PP.Implants and components: entering the new millennium. Int J Oral Maxillofac Implants. 2000;15:76-94.

English CE. Implants. Part three. An overview.CDA J. 1988;16: 34-8.



Implant Manufacturers

USA:	28
Germany:	25
Italy:	14
Korea:	8
Spain:	8
Brazil:	5
Switzerland :	5
Canada:	4
France:	4
Sweden:	4
Israel:	3
United Kingdom:	3
Other countries:	9

per 2.2007
(n=120)

Implant Manufacturers

USA:	28
Germany:	25
Italy:	14
Korea:	8
Spain:	8
Brazil:	5
Switzerland :	5
Canada:	4
France:	4
Sweden:	4
Israel:	3
United Kingdom:	3
Other countries:	9

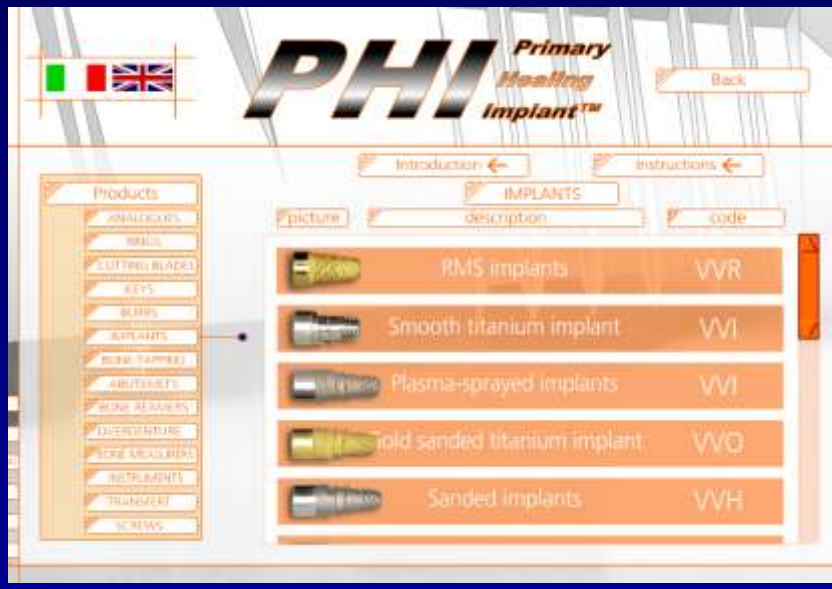
Feb 2007: n=120

Germany:	32
USA:	31
Italy:	15
Korea:	10
Spain:	10
Brazil:	9
France:	7
Japan	6
Switzerland :	6
Canada:	4
Sweden:	4
Israel:	3
United Kingdom:	3
Other countries:	9

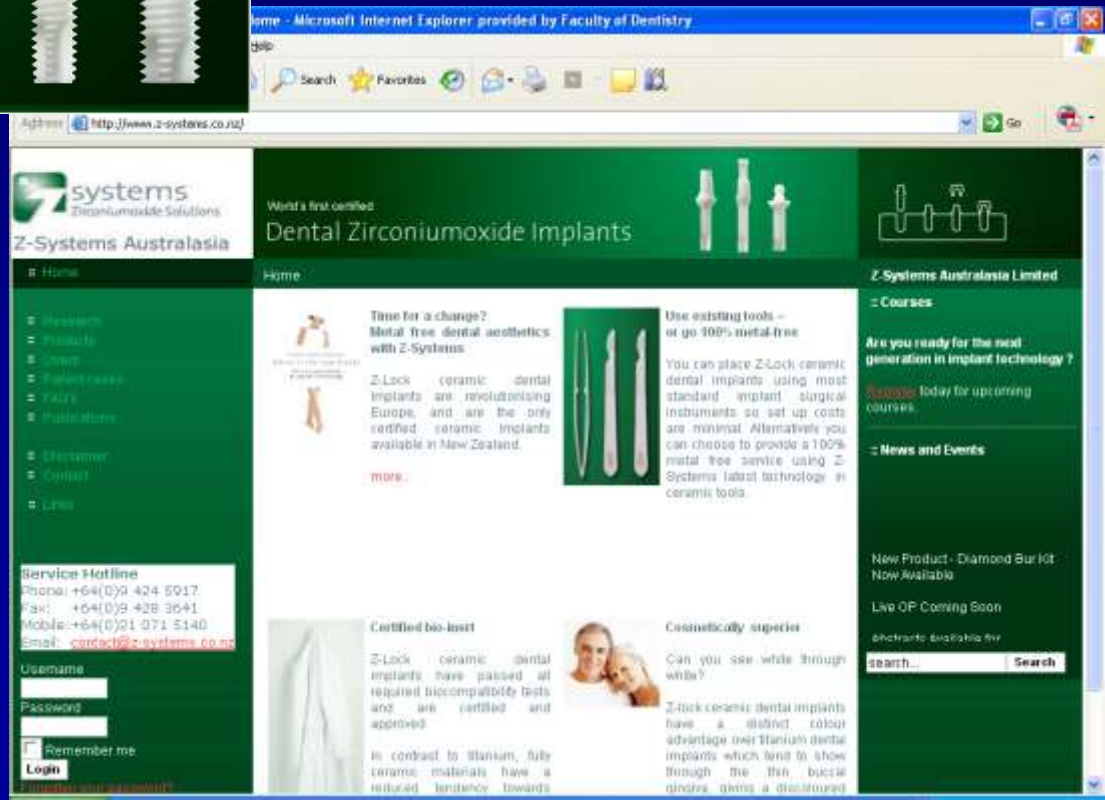
Feb. 2008?
(n=147!)

Clinical documentation of the new implant systems?

Implant systems introduced since October 2003 ?



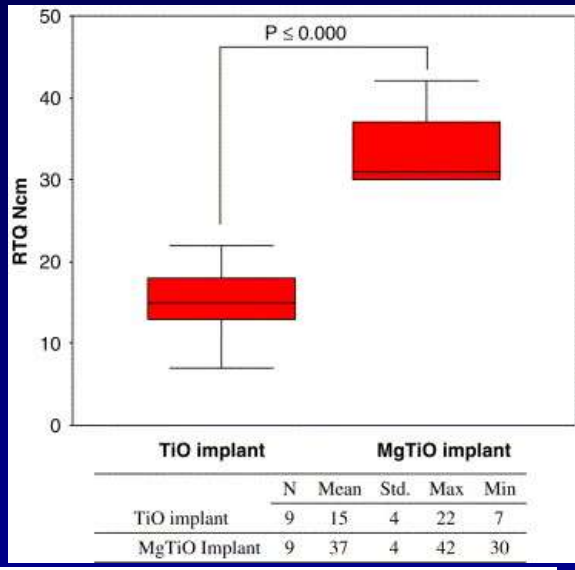
New Implant materials



New Implant surface treatment

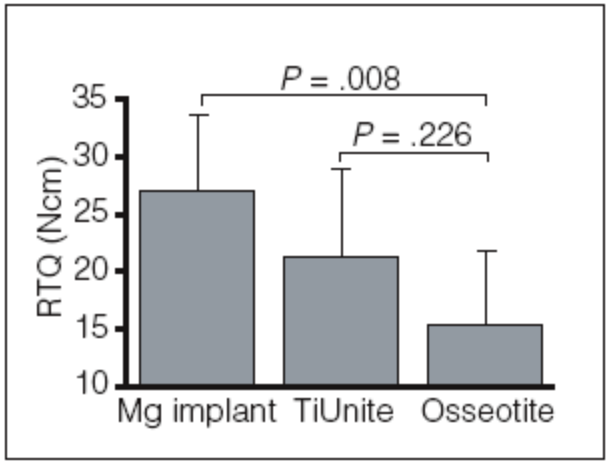
- Magnesium ion incorporated, oxidized implants ? Dr Young-Taeg Sul - Korea

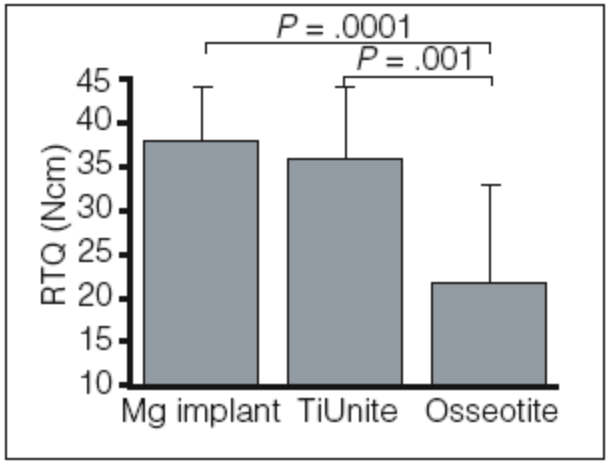
Sul YT, et al. Biomaterials. 2005 Nov;26(33):6720-30

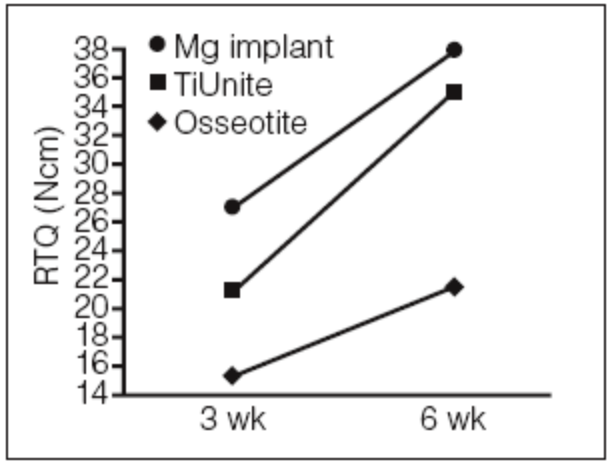


	N	Mean	Std.	Max	Min
TiO implant	9	15	4	22	7
MgTiO Implant	9	37	4	42	30

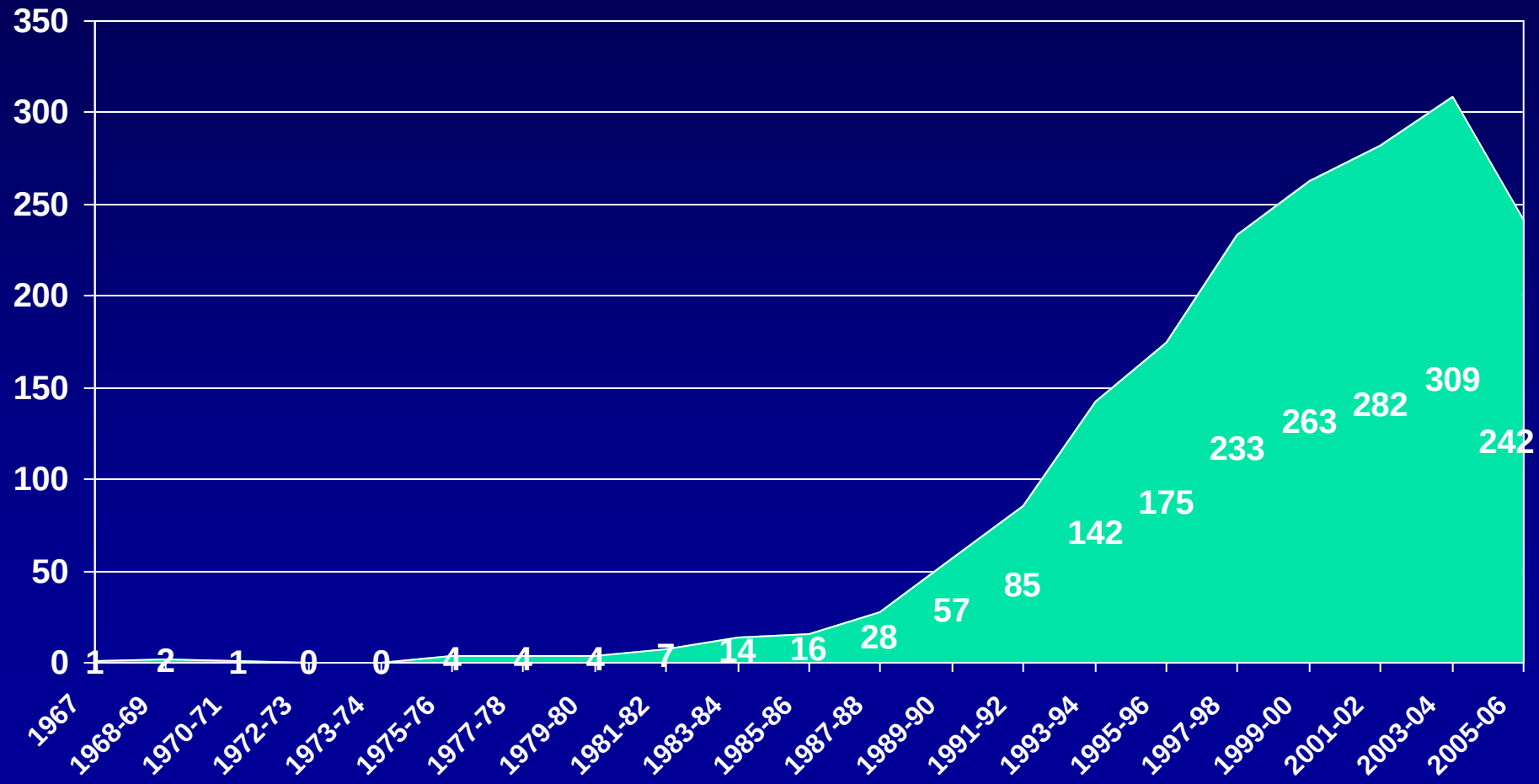
Sul YT, et al. Int J Prosthodont. 2006;19:319-28



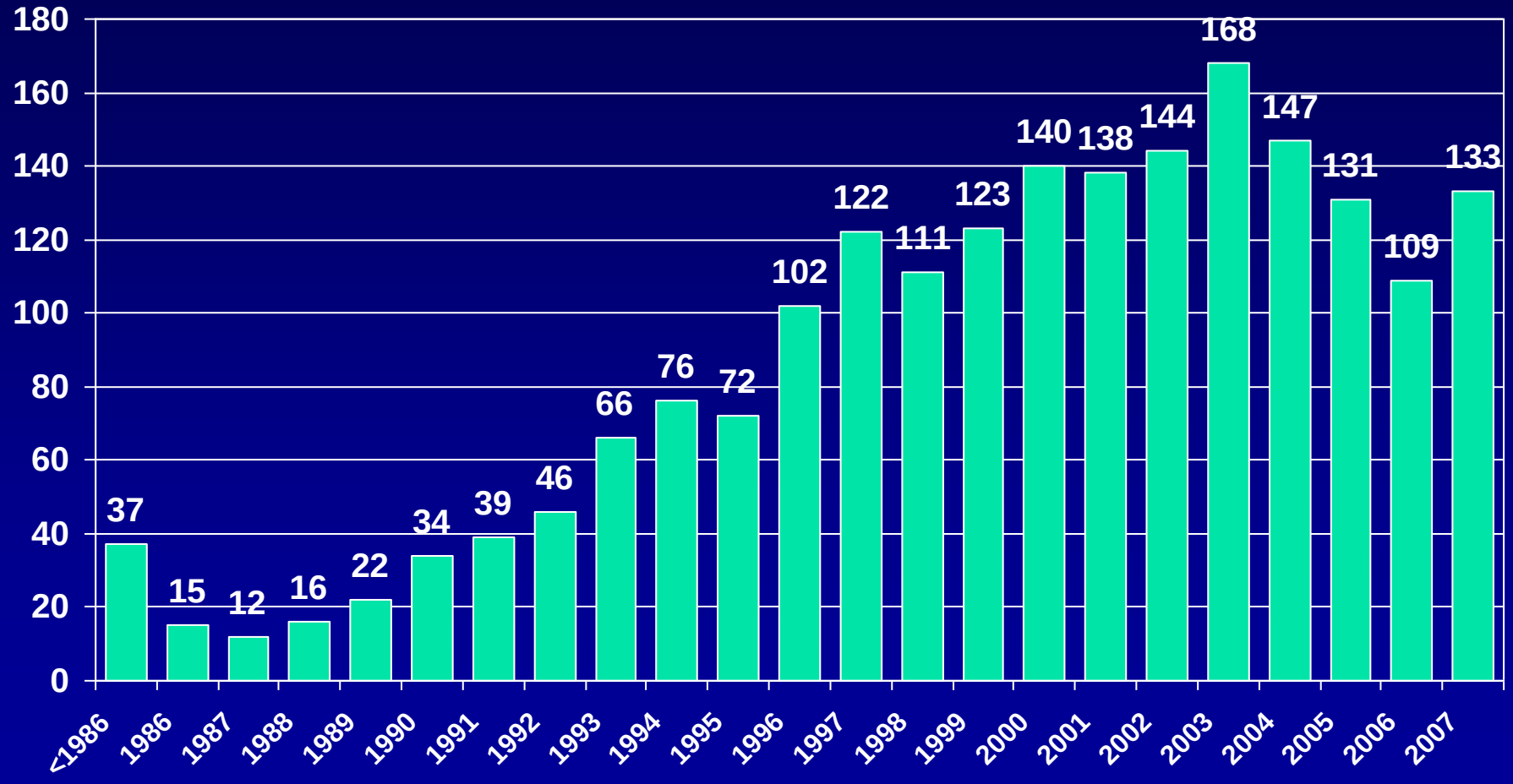




Clinical trials – Dental implants



Clinical trials – Dental implants



Clinical trials – Dental implants

Clinical trials since 2003 = 523

- Brånemark / Replace x8
- ITI /Straumann x4
- 3i/Osseotite x2
- Frialit2/Frialit+/Frialoc/Frios 1
- Astra 1

~75%


www.torontoimplantconference.ca
The Toronto Osseointegration Conference Revisited
25 years since the 1982 Toronto Conference on Osseointegration in Clinical Dentistry
What about the future?
May 8 - 10, 2008
Metro Toronto Convention Centre

Fall

2005

GPs

(Grad anest) Daily record sheet

(Grad paed)

(oral surg

(Grad endo)

IPU

(Grad perio)

Undergrad Student

+/- radiographs

+/- report

diagnostics

Master problem

Comprehensive examination form

Caries risk

Examination history

Diet

(Gen) Daily record sheet

Medical questionnaire

Consent to obtain more information

Collection, use & disclosure

Consent to use information

Medical letter

Clinical regulations

General consent (for treatment)

OD Chart audit

Emergency examination chart

Consent for emergency treatment

Referral form

Pros. Consult

Prosthodontics Graduate / staff

IPU-surgeon

Spring 2006

GPs

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(Grad endo)

IPU

(Grad perio)

Undergrad Student

+/- radiographs

+/- report

Master problem

Comprehensive examination form

Caries risk

Examination history

Diet

(Gen) Daily record sheet

Pros. Consult

all other

2 implants / student
Uncomplicated
Single crowns
or
mand. ball-overdenture

Improved Referral form

Pros. Consult

Graduate Prosthodontics /staff

IPU-surgeon

Journal of Dental Education 2006: 70: 580-588

Association Report

Teaching Implant Dentistry in the Predoctoral Curriculum: A Report from the ADEA Implant Workshop's Survey of Deans

Vicki C. Petropoulos, D.M.D., M.S.; Nancy S. Arbree, D.D.S., M.S.; Dennis Tarnow, D.D.S.; Michael Rethman, D.D.S., M.S.; Jay Malmquist, D.M.D.; Richard Valachovic, D.M.D., M.P.H.; W. David Brunson, D.D.S.; Michael C. Alfano, D.M.D., Ph.D.

Abstract: In 2004, a survey of the deans of U.S. and Canadian dental schools was conducted to determine the implant dentistry curriculum structure and the extent of incorporating implant dentistry clinical treatment into predoctoral programs. The questionnaire was mailed to the deans of the fifty-six dental schools in advance of the ADEA Implant Workshop conference held in Arizona in November 2004. Out of the fifty-six, thirty-nine responded, yielding a response rate of 70 percent.

Conclusions –predoctoral students

- Single-tooth implant restorations & implant-retained overdenture prostheses are performed in most schools
- There is no clinical competency requirement for surgical implant placement in all schools and implant prosthodontics in most schools
- Prosthodontic specialty faculty are often responsible for teaching implant prosthodontics
- Periodontics and oral and maxillofacial faculty are commonly responsible for teaching implant surgery
- Support from implant companies is common, with most providing for implant components at discounted costs
- There is a lack of adequately trained faculty in implant dentistry, which is a significant challenge in providing predoctoral students with clinical experience with dental implants.

***Journal of Dental Education* 2006: 70: 580-588**

Types of implant-related procedures restored by predoctoral students

Answer	Number of Responding Schools (%)
Single tooth molar	27 (90%)
Single tooth bicuspid	26 (87%)
Implant overdenture with two implants and ball or stud attachment	25 (83%)
Single tooth anterior	18 (60%)
Simple 2-3-4 unit free-standing fixed partial denture	10 (33%)
Implant overdenture with two implants and a bar attachment	5 (17%)
No limit	1 (3%)
Other*	

*"Other" answers given:

- Assessed on a case-by-case basis for complexity.
- We are at the very beginning of a new clinical education program. Many answers reflect what we plan to do but have not reached the point yet of doing.
- No full mouth rehab, but do fixed-detachable mandibular prosthesis.
- Many times two implants will be placed in the posterior region of the mouth. These implants are typically restored as single crowns although occasionally they are splinted together.
- Simple two-unit free-standing fixed partial denture.
- We practically have no limits. The reason we can provide this type of experience is in part due to our surgical support from perio and oral surgery as well as the time that I invest with the students to guide them through the experience. My only specific restrictions are cases that we prefer to be under the supervision of grad prosthodontics, such as: immediate loading, fixed detachable, complex implant supported bar overdenture prostheses, and other full-mouth rehabilitations.

Types of implant-related procedures restored by predoctoral students

Table 3. Types of cases for implant placement (percentages are based on the nine schools that responded to this question)

Answer	Number of Responding Schools (%)
Missing bicuspid	8 (89%)
Missing molar	7 (78%)
Fully edentulous mandible	7 (78%)
Partially edentulous mandible	4 (44%)
Missing anterior tooth	3 (33%)
Partially edentulous maxilla	3 (33%)
Fully edentulous maxilla	1 (11%)
Other (specify)	
No limits	

Comments given:
- One-on-one faculty supervision at placement time.
- We do not *require* surgical experience with patients.

***Journal of Dental Education* 2006: 70: 580-588**

Table 4. Faculty teaching implant prosthodontics

Answer	Number of Responding Schools Out of 35 (%)
Prosthodontic faculty	33 (94%)
General dental faculty	13 (37%)
Other (specify)*	4 (11%)

*"Other" answers:
- Director of implantology: restorative dentist and director, division of operative dentistry
- Oral surgery faculty and residents, periodontal faculty, prosthodontic residents
- Implantology faculty
- Implant center faculty (prosthodontists)

Table 5. Faculty who teach implant surgery to predoctoral students

Answer	Number of Responding Schools (%)
Periodontics faculty	27 (77%)
Oral and maxillofacial faculty	25 (71%)
Prosthodontic faculty	7 (20%)
General dentistry faculty	4 (11%)
Other*	5 (11%)

*"Other" answers:
- Implant Center faculty
- Implant Center faculty surgeons

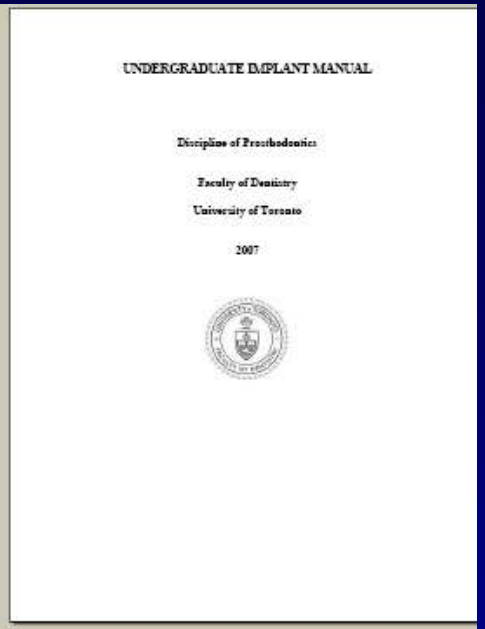
Table 6. Implant prosthodontic fee schedule

Answer	Number of Responding Schools (%)
Same as crown or denture with separate abutment fee	14 (41%)
Higher than crown or denture	9 (26%)
Other	8 (23%)
Same as crown or denture	5 (14%)
Not applicable	2 (6%)
Other (specify)*	

*"Other" answers:
- Implant is higher than a crown but fee includes surgery. Denture has separate abutment fee.
- Predoctoral fee schedule for implants is under the University Development Program, which provides special reduced fees, i.e., a single implant crown (including surgical and prosthodontic fees) is ~equivalent to the cost of a three unit FPD in the student clinic.
- Structured to be similar to crown fee so that this could be a viable option for patients who have the choice.
- For the overdentures, we charge as a package (placement of the two implants, two abutments, and the two dentures).
- We charge the standard rate for the prosthesis and an additional $200 for the implant service regardless of the number of implants used.
- Student fee: implant and crown equals 3 unit FPD at student rate.
- Separate fee for implant placement and abutment installation.
- The actual fee for the crown or the denture is the same. Obviously, there is the additional fee of the workup, surgical template, tomo or CT, and abutment (and any necessary bone grafting procedures).

Journal of Dental Education 2006: 70: 580-588

Student Information



UNDERGRADUATE IMPLANT MANUAL

Discipline of Prosthodontics

Faculty of Dentistry

University of Toronto

2007

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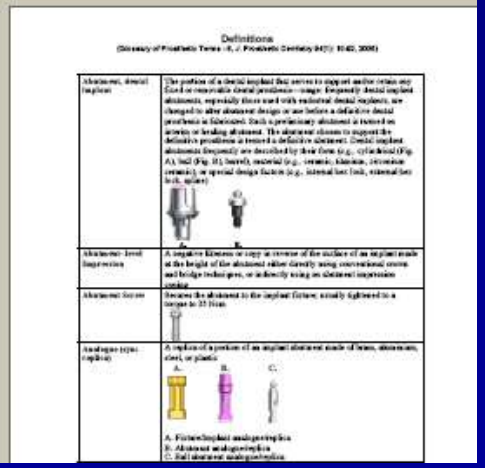
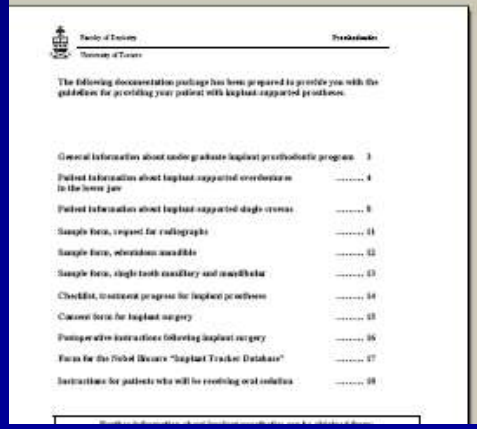
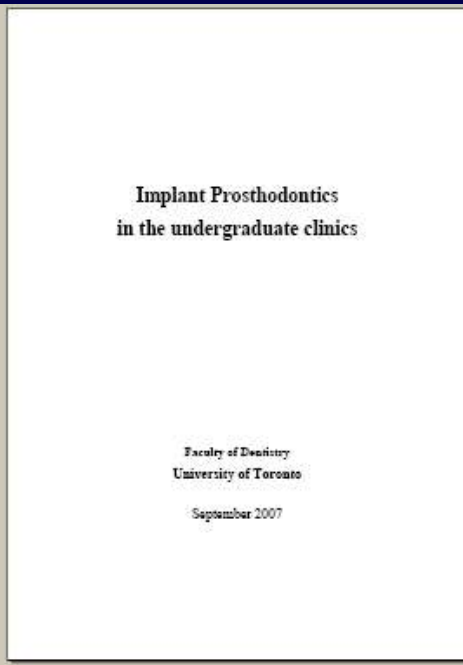


Definitions





Implant Prosthodontics
in the undergraduate clinics

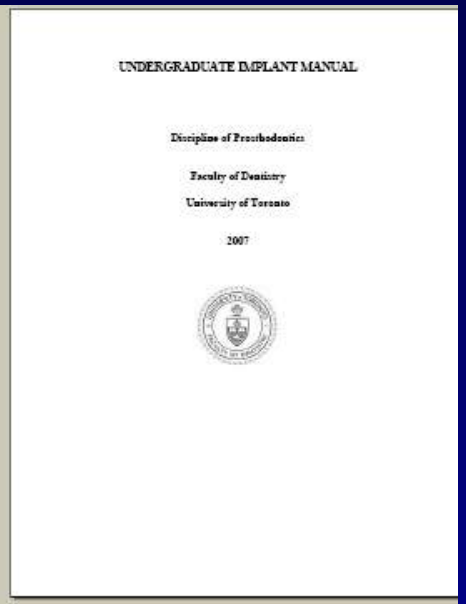
Faculty of Dentistry
University of Toronto

September 2007

Undergraduate implant Manual

Implant Prosthodontics in the undergraduate clinics

Student Information



UNDERGRADUATE IMPLANT MANUAL

Discipline of Prosthodontics

Faculty of Dentistry

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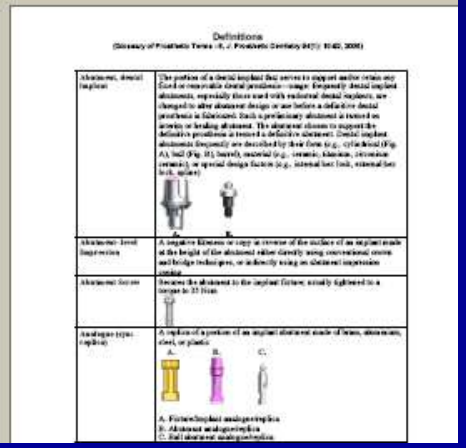


Definitions

(Glossary of Prosthetic Terms - R. J. Prosthetic Dentistry 84(1): 11-62, 2000)

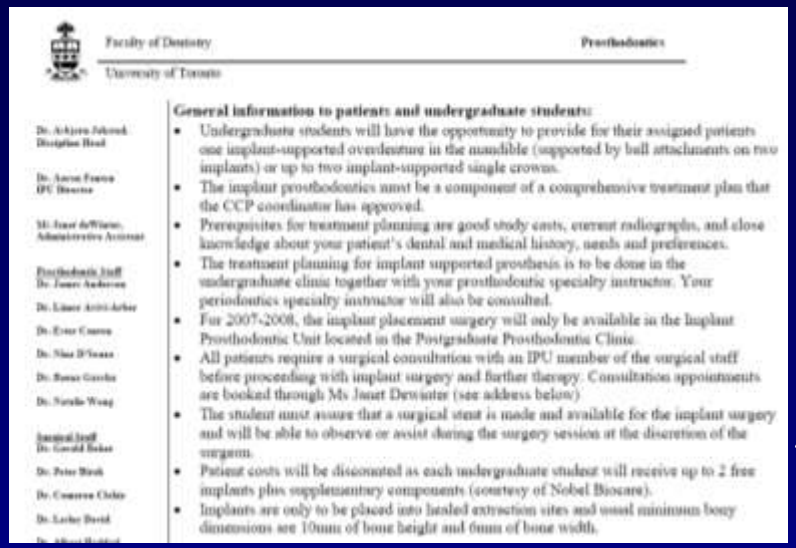
Abutment, dental implant	The portion of a dental implant that serves to support and/or retain any fixed or removable dental prosthesis—usage: frequently dental implant abutments, especially those used with endosteal dental implants, are changed to alter abutment design or use before a definitive dental prosthesis is fabricated. Such a preliminary abutment is termed an acrylic or healing abutment. The abutment chosen to support the definitive prosthesis is termed a definitive abutment. Dental implant abutments frequently are described by their form (e.g., cylindrical (Fig. A), ball (Fig. B), barrel), material (e.g., ceramic, titanium, zirconium, ceramic), or special design factor (e.g., internal hex lock, external hex lock, spline)
Abutment-level impression	A negative likeness or copy in reverse of the surface of an implant made at the height of the abutment either directly using conventional crown and bridge techniques, or indirectly using an abutment impression coping.
Abutment screw	Secures the abutment to the implant fixture, usually tightened to a torque to 35 Ncm
Analogue (type, replica)	A replica of a portion of an implant abutment made of brass, aluminum, steel, or plastic

A. Fixture/implant analogue/replica
B. Abutment analogue/replica
C. Ball abutment analogue/replica

Undergraduate implant Manual

Student Kits

Student Information



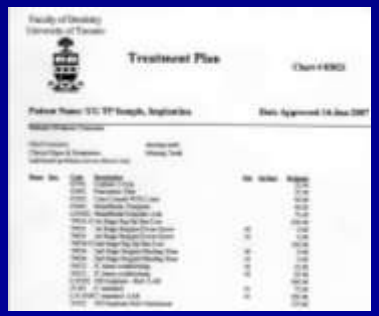
Faculty of Dentistry — Prosthodontics
University of Toronto

General information to patients and undergraduate students:

- Undergraduate students will have the opportunity to provide for their assigned patients one implant-supported overdenture in the mandible (supported by ball attachments on two implants) or up to two implant-supported single crowns.
- The implant prosthodontics must be a component of a comprehensive treatment plan that the CCP coordinator has approved.
- Prerequisites for treatment planning are good study casts, current radiographs, and close knowledge about your patient's dental and medical history, needs and preferences.
- The treatment planning for implant supported prosthesis is to be done in the undergraduate clinic together with your prosthodontic specialty instructor. Your periodontics specialty instructor will also be consulted.
- For 2007-2008, the implant placement surgery will only be available in the Implant Prosthodontic Unit located in the Postgraduate Prosthodontic Clinic.
- All patients require a surgical consultation with an IPU member of the surgical staff before proceeding with implant surgery and further therapy. Consultation appointments are booked through Ms Jouet Dewinter (see address below)
- The student must assure that a surgical stent is made and available for the implant surgery and will be able to observe or assist during the surgery session at the discretion of the surgeon.
- Patient costs will be discounted as each undergraduate student will receive up to 2 free implants plus supplementary components (courtesy of Nobel Biocare).
- Implants are only to be placed into healed extraction sites and must minimum bony dimensions are 10mm of bone height and 6mm of bone width.

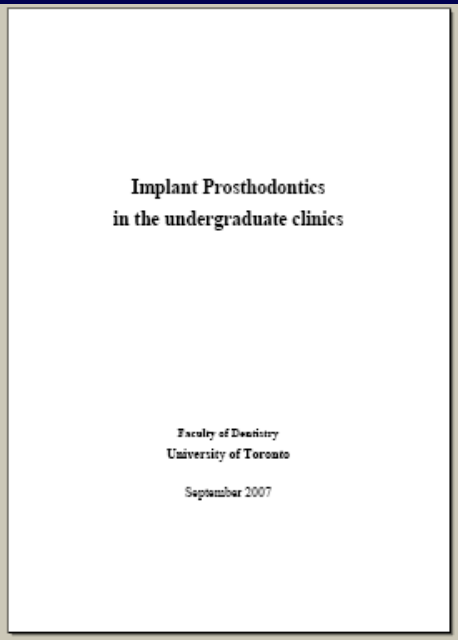
General Information

Treatment Plan



Treatment Plan

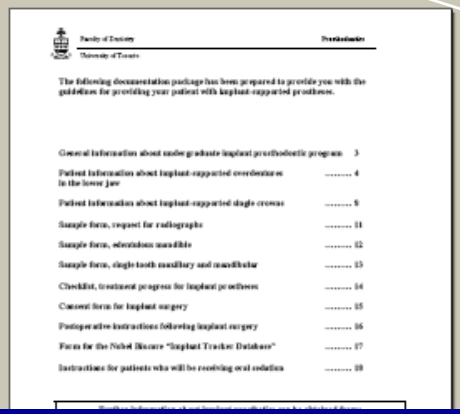
Cost estimates (Implantina)



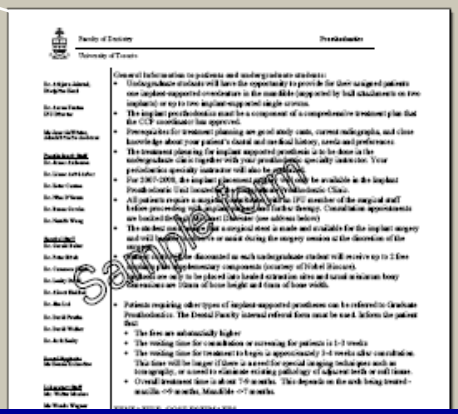
Implant Prosthodontics
in the undergraduate clinics

Faculty of Dentistry
University of Toronto

September 2007



The following documentation package has been prepared to provide you with the guidelines for providing your patient with implant-supported prostheses.



Implant Prosthodontics in the undergraduate clinics